

WHAT IS CLAIMED IS:

1. A method of making a cheese base, the method comprising:  
mixing milk or a milk derivative with a chelating agent in a manner that provides sufficient turbulence at the locus of mixing such that localized protein precipitation is avoided and adding the chelating agent in an amount sufficient to chelate calcium; and  
subjecting the milk or the milk derivative to ultrafiltration thereby passing calcium freed from the milk or milk derivative with a permeate and obtaining a retentate cheese base.
2. The method of claim 1 wherein the chelating agent lowers the pH of the milk or the milk derivative to be between about 5.8 and 6.6.
3. The method of claim 2 and wherein the chelating agent is added to the milk or the milk derivative to adjust the pH of the milk to about 6.2.
4. The method of claim 1 wherein the chelating agent is citric acid.
5. The method of claim 1 and introducing substantially with the chelating agent into the turbulent flowing milk or milk derivative stream an acidification agent in an amount sufficient to lower the pH of the milk or milk derivative stream to a pH between about 5.8 and 6.6.
6. The method of claim 5 wherein the chelating agent and the acidification agent are introduced substantially simultaneously into the milk or milk derivative stream.

7. The method of claim 5 wherein the acidification agent comprises tannic acid, malic acid, gluconic acid, citric acid, glycolic acid, pyruvic acid, glutamic acid, fumaric acid, succinic acid, isocitric acid, pimelic acid, oxalic acid, malonic acid, gluratic acid, adipic acid, acetic acid, propionic acid, butyric acid, acetic anhydride, butyric anhydride or succinic anhydride or any combination thereof.
8. The method of claim 1 wherein the chelating agent comprises ethylenediaminetetraacetate, pyrophosphate, citric acid, malic acid, gluconic acid, sodium citrate, disodium citrate, potassium citrate, sodium carbonate, potassium carbonate, sodium bicarbonate, potassium bicarbonate, sodium tripolyphosphate, sodium hexa metaphosphate, sodium acid pyrophosphate, monopotassium dihydrogen orthophosphate, dipotassium hydrogen orthophosphate, tripotassium orthophosphate, monosodium phosphate, dipotassium phosphate, trisodium phosphate, tetrasodium pyrophosphate, sodium aluminum phosphate, sodium potassium tartrate, or mixtures thereof.
9. The method of claim 1 and wherein the chelating agent is added under conditions providing a Reynolds number of at least about 5000.
10. The method of claim 4 and wherein the citric acid is added to the milk or the milk derivative in about a 10 weight percent solution.
11. The method of claim 1 and further comprising adding an emulsifying salt to the retentate cheese base.

12. The method of claim 1 and further comprising adding a culture to the retentate cheese base wherein the culture ferments the retentate cheese base to form a fermentate.

13. The method of claim 9 and further comprising adding rennet to the fermentate.

14. The method of claim 1 and further comprising evaporating water from the retentate cheese base such that the cheese base has a moisture content approximately equal to a moisture content of a cheese-based product of which the retentate cheese base is an ingredient.

15. The cheese base produced by the method of claim 1 characterized by a softer texture than a cheese base having no calcium extracted from a milk ingredient.

16. The cheese base produced by the method of claim 1 characterized by a reduction in calcium of at least 5% relative to a cheese base having no calcium extracted from a milk ingredient.

17. The cheese base of claim 9 and wherein the cheese base comprises an ingredient of a process cheese, a cheese food, a cheese spread, a cheese sauce or an imitation or analog cheese.

18. The cheese base of claim 14 and wherein the cheese base comprises an ingredient of a process cheese, a cheese food, a cheese spread, a cheese sauce or an imitation or analog cheese.

19. A method of continuously making a cheese base, the method comprising:
- providing a stream of milk or a milk derivative having turbulent flow characteristics;
  - introducing a chelating agent into the turbulent flowing milk or milk derivative stream in a manner such that the chelating agent does not produce localized conditions that causes proteins in the milk or the milk derivative stream to precipitate and chelates calcium such that calcium is freed from the milk or the milk derivative and is bound by the chelating agent; and
  - subjecting the milk to ultrafiltration to remove the free calcium from the milk as permeate along with water such that retentate has a reduced calcium concentration.
20. The method of claim 19 and introducing with the chelating agent into the turbulent flowing milk or milk derivative stream an acidification agent in an amount sufficient to lower the pH of the milk or milk derivative stream to a pH between about 5.8 and 6.6.
21. The method of claim 20 wherein the chelating agent and the acidification agent are introduced substantially into the milk or milk derivative stream.
22. The method of claim 19 wherein the chelating agent lowers the pH of the milk or milk derivative stream to between about 5.8 and 6.6.
23. The method of claim 21 wherein the chelating agent is citric acid.

24. The method of claim 20 wherein the acidification agent comprises tannic acid, malic acid, gluconic acid, citric acid, glycolic acid, pyruvic acid, glutamic acid, fumaric acid, succinic acid, isocitric acid, pimelic acid, oxalic acid, malonic acid, glutaric acid, adipic acid, acetic acid, propionic acid, butyric acid, acetic anhydride, butyric anhydride or succinic anhydride or any combination thereof.

25. The method of claim 19 wherein the chelating agent comprises ethylenediaminetetraacetate, pyrophosphate, citric acid, malic acid, gluconic acid, sodium citrate, disodium citrate, potassium citrate, sodium carbonate, potassium carbonate, sodium bicarbonate, potassium bicarbonate, sodium tripolyphosphate, sodium hexa metaphosphate, sodium acid pyrophosphate, trisodium phosphate, monopotassium dihydrogen orthophosphate, dipotassium hydrogen orthophosphate, tripotassium orthophosphate, monosodium phosphate, dipotassium phosphate, tetrasodium pyrophosphate, sodium aluminum phosphate, sodium potassium tartrate, or mixtures thereof.

26. The method of claim 19 and wherein the chelating agent is added under conditions providing a Reynolds number of at least about 5000.

27. The method of claim 19 and wherein the calcium content of the retentate is reduced at least 5% relative to a cheese base having no calcium extracted from a milk ingredient.

28. The method of claim 19 and wherein the chelating agent comprises citric acid.

29. The method of claim 28 and wherein the citric acid comprises about a ten weight percent solution of citric acid.

30. The method of claim 19 and further comprising adding an emulsifying salt to the retentate cheese base.
31. The method of claim 29 and further comprising adding a culture to the retentate wherein the culture ferments the retentate to form a fermentate.
32. The method of claim 31 and further comprising adding rennet to the fermentate.
33. The method of claim 19 and further comprising evaporating water from the retentate cheese base such that the cheese base has a moisture content approximately equal to a moisture content of a cheese-based product of which the retentate cheese base is an ingredient.
34. The method of claim 31 and further comprising evaporating water from the retentate such that the retentate has a moisture content approximately equal to a moisture content of a product of which the retentate is an ingredient.
35. The cheese base produced by the method of claim 19 characterized by a softer texture than a cheese base having no calcium extracted from a milk ingredient.
36. The cheese base produced by the method of claim 19 characterized by a reduction in calcium of at least 5% relative to a cheese base having no calcium extracted from a milk ingredient.

37. The cheese base produced by the method of claim 34 characterized by a reduction in calcium of at least 5% relative to a cheese base having no calcium extracted from a milk ingredient.

38. The cheese base of claim 35 and wherein the cheese base comprises an ingredient of a process cheese, a cheese food, a cheese sauce, a cheese spread, or an imitation or analog cheese.

39. The cheese base of claim 36 and wherein the cheese base comprises an ingredient of a process cheese, a cheese food, a cheese sauce, a cheese spread, or an imitation or analog cheese.

40. The cheese base of claim 34 and wherein the cheese base comprises an ingredient of a process cheese, a cheese food, a cheese sauce, a cheese spread, or an imitation or analog cheese.

41. A method of preventing membrane fouling during the removal of calcium from milk or a milk derivative during ultrafiltration, the method comprising:

providing a stream of milk or a milk derivative having turbulent flow characteristics;

introducing a chelating agent into the turbulent flowing milk or milk derivative stream in a manner such that the chelating agent does not produce localized reduced pH locations that cause proteins in the milk or milk derivative stream to precipitate and wherein calcium is freed from the milk or milk derivative and bound by the chelating agent; and

subjecting the milk or milk derivative to ultrafiltration to remove the calcium from the milk as permeate along with water such that the calcium does not foul the membrane.

42. The method of claim 41 and introducing substantially simultaneously with the chelating agent into the turbulent flowing milk or milk derivative stream an acidification agent in an amount sufficient to lower the pH of the milk or milk derivative stream to a pH between about 5.8 and 6.6.

43. The method of claim 41 wherein the chelating agent lowers the pH of the milk or milk derivative stream to between about 5.8 and 6.6.

44. The method of claim 43 and wherein the chelating acid comprises citric acid.

45. The method of claim 44 and wherein the citric acid comprises no more than a ten weight percent solution of citric acid.

46. The method of claim 42 wherein the acidification agent comprises tannic acid, malic acid, gluconic acid, citric acid, glycolic acid, pyruvic acid, glutamic acid, fumaric acid, succinic acid, isocitric acid, pimelic acid, oxalic acid, malonic acid, gluratic acid, adipic acid, acetic acid, propionic acid, butyric acid, acetic anhydride, butyric anhydride or succinic anhydride or any combination thereof.

47. The method of claim 41 wherein the chelating agent comprises ethylenediaminetetraacetate, pyrophosphate, citric acid, malic acid, gluconic acid, sodium citrate, disodium citrate, potassium citrate, sodium carbonate, potassium carbonate, sodium bicarbonate, potassium bicarbonate, sodium



tripolyphosphate, sodium hexa metaphosphate, sodium acid pyrophosphate, trisodium phosphate, monopotassium dihydrogen orthophosphate, dipotassium hydrogen orthophosphate, tripotassium orthophosphate, monosodium phosphate, dipotassium phosphate, tetrasodium pyrophosphate, sodium aluminum phosphate, sodium potassium tartrate, or mixtures thereof.

48. The method of claim 41 and wherein the chelating agent is added under conditions providing a Reynolds number of at least about 5000.

49. A method of making a cheese base, the method comprising:  
adding a chelating agent to milk or a milk derivative in a turbulent manner sufficient to avoid localized protein precipitation at a pH in an approximate range of 5.8 to 6.6; and  
ultrafiltering the milk or milk derivative thereby passing freed calcium with a permeate and retaining a retentate suitable as the cheese base.

50. The method of claim 49 and introducing with the chelating agent into the turbulent flowing milk or milk derivative stream an acidification agent in an amount sufficient to lower the pH of the milk or milk derivative stream to a pH between about 5.8 and 6.6.

51. The method of claim 50 wherein the chelating agent and the acidification agent are introduced substantially simultaneously.

52. The method of claim 49 wherein the chelating agent is citric acid.

53. The method of claim 49 and wherein the chelating agent is added under conditions providing a Reynolds number of at least about 5000.

54. The method of claim 50 wherein the acidification agent comprises tannic acid, malic acid, gluconic acid, citric acid, glycolic acid, pyruvic acid, glutamic acid, fumaric acid, succinic acid, isocitric acid, pimelic acid, oxalic acid, malonic acid, gluratic acid, adipic acid, acetic acid, propionic acid, butyric acid, acetic anhydride, butyric anhydride or succinic anhydride or any combination thereof.

55. The method of claim 49 wherein the chelating agent comprises ethylenediaminetetraacetate, pyrophosphate, citric acid, malic acid, gluconic acid, sodium citrate, disodium citrate, potassium citrate, sodium carbonate, potassium carbonate, sodium bicarbonate, potassium bicarbonate, sodium tripolyphosphate, sodium hexa metaphosphate, sodium acid pyrophosphate, trisodium phosphate, monopotassium dihydrogen orthophosphate, dipotassium hydrogen orthophosphate, tripotassium orthophosphate, monosodium phosphate, dipotassium phosphate, tetrasodium pyrophosphate, sodium aluminum phosphate, sodium potassium tartrate, or mixtures thereof.

56. The method of claim 52 and wherein the citric acid is added to the milk or the milk derivative in about a 10 weight percent solution.

57. The method of claim 49 and further comprising adding an emulsifying salt to the retentate cheese base.

58. The method of claim 49 and further comprising adding a culture to the retentate wherein the culture ferments the retentate to form a fermentate.

59. The method of claim 58 and further comprising adding rennet to the fermentate.

60. The method of claim 49 and further comprising evaporating water from the retentate such that the retentate has a moisture content approximately equal to a moisture content of a product of which the retentate is an ingredient.

61. The method of claim 58 and further comprising evaporating water from the retentate such that the retentate has a moisture content approximately equal to a moisture content of a product of which the retentate is an ingredient.

62. The cheese base produced by the method of claim 44 characterized by a softer texture than a cheese base having no calcium extracted from a milk ingredient.

63. The cheese base produced by the method of claim 55 characterized by a reduction in calcium of at least 5% relative to a cheese base having no calcium extracted from a milk ingredient.

64. A cheese base produced by the method of claim 61 characterized by a reduction in calcium of at least 5% relative to a cheese base having no calcium extracted from a milk ingredient.

65. The cheese base of claim 62 and wherein the cheese base comprises an ingredient of a process cheese, a cheese food, a cheese spread, a cheese sauce or an imitation or analog cheese.